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Abstract

It is expected that by the year 1990 that at least 40 million workers will be using video display terminals (VDT's) in the workplace. There are also 1 million VDT's already in schools and that number is likely to increase. With this increase in VDT usage it appears likely that visual symptoms associated with them will also increase. We as optometrists have an opportunity to provide a special service to our patients in this area but first we must understand the unique properties of VDT's which cause visual symptoms and then prescribe measures to overcome them. 1

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A CLINICIANS GUIDE TO THE DIAGNOSIS AND REMEDIATION OF VDT RELATED VISION PROBLEMS

BY

GEORGE SISSON

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove , Oregon
for the degree of
Doctor of Optometry
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About the author: I , George Sisson , was born and raised in Oregon. I attended Nestucca Union High School and upon graduation entered Pacific University where I recieved a Bachelor of Science degree in Visual Science. Upon graduation from optometry school I plan to join a private practice which emphasizes primary care.

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Abstract: It is expected that by the year 1990 that at least 40 million workers will be using video display terminals (VDT's) in the workplace. There are also 1 million VDT's already in schools and that number is likely to increase. With this increase in VDT usage it appears likely that visual symptoms associated with them will also increase. We as optometrists have an opportunity to provide a special service to our tients in this area but first we must understand the unique properties of DT's which cause visual symptoms and then prescribe measures to overcome them.

Introduction: We are in the midst of a revolution in the workplace. This revolution is the use of computers in nearly all areas of business. Computers have brought us increased productivity and have greatly reduced the labor needed for certain tasks but they have also caused increase stress and strain to the visual systems of those who use them.

In a recent unscientific poll of optometrists by the American Optometric Association News the majority of optometrists responding reported that the greatest number of job-related visual complaints expressed by patients were due to VDT use.[1] Other studies have also indicated a significantly high incidence of visual complaints are experienced by VDT operators.[2,3]

VDT's AS A HEALTH HAZARD

The use of VDT's has brought with it the fear that there may be harmful x-ray or other radiation emissions which may cause permanent health damage. Tests have been conducted which show the levels of x-rays and other radiation to be well below the level considered to be dangerous. Indeed, the level of radiation which reaches us from the sun and the universe is far greater than any radiation reaching us from a television set or VDT screen.[4]

HOW VDT's WORK

To understand the nature of VDT viewing , one must first examine how a VDT works. A VDT is composed of a cathode ray tube which has an electron gun on one end and a phosphor screen on the other. The electron beam sweeps back and forth exciting the phosphor material and causing it to glow. This produces a spot on the screen and a number of spots produce

a character.

The screen must be constantly refreshed which means the electron beam must continually sweep back and forth re-exciting the phosphor. As long as the refresh rate is in the range of fifty to sixty Hertz , the image on the screen will appear steady. If the refresh rate falls below this level then the image may appear to flicker.

As is evident already , VDT's differ from traditional hardcopy material in that they are a light emitting rather than a light reflecting source. This in itself may partly explain why there is a greater number of visual complaints with VDT's as opposed to traditional hardcopy material.

ERGONOMIC FACTORS

Ergonomics is the study of man in relation to his work environment. Proper placement of both the workstation and the operator in relation to it may relieve many of the symptoms reported by VDT operators.

There are five factors to consider when trying to achieve good ergonomic design:

1. Task Factors-The number of visual symptoms a VDT operator experiences can be directly related to the type of task he or she performs since some tasks require a greater amount of time to be spent viewing the VDT screen.[5] If the task is a question-answer type task (person types the question into the computer and waits for an answer) they will be more likely to stare at the screen for extended periods of time causing a drying of the eyes.

If the task is a creative type task such as programming there will be a reduced risk of symptoms as opposed to repetitive monotonous tasks. Therefore it may be advisable for the employer to provide a variety of tasks or have their workers switch work duties in order to avoid staring at the screen.

An input type task is one in which the user reads information off hard

copy or listens to dictated information and enters this into the computer. If the information comes from hard copy , special consideration must be made to insure proper lighting. As will be discussed further on , the optimum lighting for VDT's and hardcopy are different.

2. Visual Factors-This area involves the visual characteristics of the VDT display.

Legibility of the display is , of course , quite important and is influenced by the following :

a) Character size-The characters should be equivelant to 20/60 to 20/80 Snellen letters. This is approximately 3.1 to 4.2 millimeters at 70 centimeters. Also, dividing the character width by the character heighth yields what is known as the aspect ratio. The optimum aspect ratio is .70.

b) Inter-character spacing-Most screens allow for 80 characters per line with a 25 line maximum. The spacing between the lines should be 1 to 1.5 times the character height.

c)Image stability-The main problem experienced by operators concerning image stability is flicker. As mentioned previously, flicker occurs when the refresh rate falls below 55 to 60 Hertz. Flicker may be more readily noticed by younger operators due to the fact that they generally have larger pupils. Also , flicker is more readily noticed when the brightness or density of the display is increased and if the ambient lighting is very bright.[6]

d) Screen color-In the unaccommodated eye at six meters , light with a wavelength of 650 nanometers is in focus on the retina. As the eye accommodates , the wavelength in focus moves toward shorter wavelengths. At 50 centimeters the wavelength in focus is approximately 520 nanometers. This would indicate that a green phosphor screen is probably the clearest for a 50 centimeter working distance. This is substantiated by preference tests given to VDT users.[7]

3) Seating and Table adjustment-First and foremost is the need for adjustable seating. A simple change of posture at different times throughout the day can be very stress relieving. `

Screen height-The screen should be positioned so that the operators head is inclined forward 20 degrees with the eyes directed down 20 degrees from the primary position. The keyboard should be detachable from the screen in order to allow variability of arm and hand placement.[8]

4) Environmental Factors:

a) Heat-VDT's and other equipment associated with them produce a considerable amount of heat. This is of special concern when dealing with contact lens patients since the heat may cause a drying of the lens and symptoms such as a dry, gritty feeling may be reported.

b) Noise-Noise may not directly cause vision problems but it does contribute to the overall stress of the VDT work environment. Measures to reduce the amount of noise in the workplace should be implemented.

c) Illumination-Probably the best type of illumination is indirect. This is to insure that the lighting element itself will not cause a bothersome reflection on the VDT screen.[9]

The National Institute of Occupational Safety and Health (NIOSH) recommends that the lighting level in the VDT work area be maintained between 500and 700 lux.[10] The Optometric Extension Program recommends a lighting level which produces a 10:3:1 ratio of the character light level , the level of ambient lighting , and the light level of the screen background.[11] In many cases the optimum level of illumination is that which provides reduced glare and discomfort while viewing the VDT screen and still allows comfortable reading of source documents.

d) Glare-One of the major sources of discomfort for VDT users is glare. This may be produced by room lighting or by sunlight. One way to test for glare is the mirror test. This involves moving a mirror around on the

surface of the screen in order to detect reflections which may be bothersome.

The placement of the VDT is critical in reducing glare. The VDT should never be placed facing a window and reflective sources in the room should be placed in such a way as to not cause reflections on the screen. The sides of the VDT unit should be parallel to the rows of overhead lights. Also , diffusers should be used on all overhead lighting to deflect the light rather than allowing it to come straight down.[12]

Desktops which have a smooth glossy finish should never be used for placement of VDT's. Instead, a matte or other dull finish which is much less likely to cause reflections should be used. The walls surrounding the VDT workstation should be painted with a flat base paint instead of a gloss type paint in order to further reduce bothersome reflections.

Other ways to reduce glare and reflections include:[13]

1) Anti-reflection coating-While this helps to reduce glare it also makes dust and fingerprints more noticeable. Therefore it will be necessary to clean the screen more often.

2) Diffusing surface-This is when the display screen is given a rough texture to make it optically irregular. This tends to "soften" reflections by spreading the reflections over a wider area.

3) Contrast-enhancement filters-Some VDT screens have these built into the screen to reduce the amount of light passing through it. Also , filters may be purchased to place in front of the screen.

4) Contrast-enhancement devices-This is a fine wire mesh which may be stretched over the surface of the display screen. These are especially effective at absorbing oblique rays. These do , though , result in a loss of resolution of the display image.

e) Visual relief area-It is recommended that there be an area behind the VDT which allows the user to look out and relax his/her

accommodative system.[14]

f) Rest periods-It is recommended that a 15 minute break be taken every 2 hours when the operator is performing under a light to moderate workload. When performing under a heavy workload which involves viewing the VDT screen 60 percent of the time or more then a 15 minute break should be taken every hour.[15]

VISUAL SYMPTOMS RELATED TO VDT USE

Patients may present with a variety of symptoms which can be directly related to VDT use. Some of these are listed below:

a) Blurred vision-A rather common complaint following extended VDT use is blurred distance vision. This is probably due to a spasm of the ciliary muscle.[16] One way to relieve these spasms of the ciliary musculature is the use of plus lenses. Also , accommodative facility training may be helpful in increasing the flexibility of the accommodative system. Generally , though , the provision of a visual relief area combined with rest periods helps to relieve any spasms of the ciliary muscle which may occur.

b) General visual discomfort-All the symptoms sometimes related to hardcopy are also exhibited with VDT use but generally with a greater frequency. The first symptoms noticed by the patient are usually a sensation of tiredeness around the eyes , irritation around the eyes , and/or red eyes. Double vision also may occur but this is quite rare.[17]

It has been shown that accommodation is less acurate to the VDT image than to hardcopy.[18] This may contribute to the visual discomfort experienced by VDT operators.

c) Headaches-Headaches associated with eyestrain may vary as to the time of onset and the location of the pain but generally they are located in the forehead and occur during or soon after the performance of visually demanding tasks. Eyestrain may also be a predetermining factor to the

development of migraine headaches.[19]

d) Dry eyes-Patients may complain of a sandy, gritty feeling which is due to drying of the cornea. This is generally associated with question and answer type operations in which the patient is staring at the screen while waiting for information to be displayed. Lubricating/wetting drops may be prescribed or the operator can be taught to consciously blink to avoid drying of the eyes.

THE VISION EXAMINATION

Prior to performing a vision exam on a VDT operator , it can be very helpful to have the patient answer a questionnaire. The questionnaire should inquire about the following:

1. Date of last examination if any.
2. Approximate length of time the patient has been a VDT operator.
3. Number of hours of VDT work per day.
4. Length of a typical session , if not continuous.
5. Size of screen characters and form (letters , numbers , mixture)
6. Size of print on additional documents.
7. Position of display screen (above eye level , at eye level , below eye level).
8. Working distances (to screen , to keyboard , to documents).
9. Symptoms , if any , associated with VDT work.

If a questionnaire is not used then these questions should be asked during the case history.

The actual vision examination itself varies little from regular vision exams with the exception that special emphasis should be placed on the near vision portion of the exam. The AOA's guidelines for a minimum optometric examination are:[20]

1. Complete case history (ocular , physical , occupational , and other pertinent information).

2. Naked visual acuity/or visual acuity of each eye uncorrected and with best correction.

3.Detailed report of external findings(lids , cornea , sclera , etc.).

4. Ophthalmoscopic examination (media , fundus , blood vessels , disc).

5. Corneal curvature measurement (dioptric , keratometry) readings.

6. Static retinoscopy/ objective refraction of each eye.

7. Amplitude of convergence and accommodation.

8. Phoria and duction findings: horizontal and vertical , distance and near.

9. Subjective findings/subjective refraction of each eye for distance and near vision with phoropter or adequate trial case and trial frame.

10. Fusion and stereopsis.

11. Color vision.

12. Visual fields and/or tonometry.

In certain cases a small change in correction can relieve the eye strain. This is especially true concerning the correction of astigmatism. The amount of uncorrected astigmatism may be such as to not be noticed in most circumstances but may be a source of discomfort after prolonged near work such as when viewing a VDT screen for extended periods.[21]

It is generally recommended that a complete vision examination be given to VDT operators annually. It is also recommended that a complete vision exam be given prior to starting work involving the use of a VDT.[22]

PRESCRIBING FOR VDT OPERATORS

As mentioned previously, even small uncorrected refractive errors can produce considerable discomfort for VDT operators.

Presbyopic operators need special consideration since the conventional near correction for 40 centimeters is generally too restrictive for viewing a VDT screen at the more usual 65 to 70 centimeter distance.

Special consideration must be given to the segment height when fitting

bifocals. Generally the segment should be fit higher than the usual bifocal in order to avoid excessive head tilt. Also, the bifocal should be as wide as possible to avoid unnecessary head turning when viewing the VDT screen. In order to allow the operator to see the keyboard, source documents, and the screen clearly it may be necessary to move the source documents and the keyboard as close to the screen as possible. If this is not possible then a trifocal may need to be added. This presents additional problems in that traditional trifocals generally are not large enough for viewing an extended area. Several lenses have been developed to eliminate this problem.

Optical Radiation Corporation produces the Orcolite CRT lens which is designed to provide a larger viewing area through the intermediate portion of the lens. The CRT lens provides a 14 millimeter wide intermediate segment as opposed to the traditional 7 millimeter segment.[23]

Also available is the Datalite^{tm} CRT trifocal lens from Vision-Ease. This lens also provides a 14 millimeter wide intermediate segment. What makes this lens unique is that the trifocal power is 66 percent of the bifocal power instead of the usual 50 percent. This allows the operator to read from hardcopy at the usual 40 centimeters and place the VDT screen at 55 to 60 centimeters.

Many times the spectacles provided for use with a VDT are not useful for other activities due to their power and/or segment height. In these cases it will be necessary to explain this to the patient and recommend that they use one pair of glasses strictly for VDT viewing and one pair for other activities. When this is the case , the glasses may be prescribed so that the usual distance portion is for viewing the VDT screen and the add is for viewing the keyboard and source documents. It should be stressed to the patient that these are strictly for VDT viewing and should be left at the work station. One way to do this is to refer to this pair as terminal

spectacles.

Tints are sometimes used to reduce reflections and glare. A light pink, gray, or brown tint may be used in an attempt to reduce bothersome reflections.

Anti-reflection coatings are also used to reduce glare and bothersome reflections.

The Hi-Tech Computercote from High-Tech^{tm} sunglasses combines an anti-reflection coating and a tint. They are produced in violet for use with green screens, gray for use with black and white screens, and blue for use with amber screens.

VISION THERAPY

Vision therapy may be helpful in reducing or eliminating some of the symptoms experienced by VDT operators. While spectacles , proper ergonomic and environmental design do help relieve visual symptoms experienced by many VDT operators , those with well developed binocular and/or oculomotor anomalies may need vision therapy. In some cases these anomalies may not surface until an individual begins work involving the use of a VDT.[24]

VDTS , BUSINESS , AND OPTOMETRY

The eyecare needs of VDT operators is a major concern for labor unions with some already calling on management to financially provide for at least a portion of the operators eyecare needs. Just recently Suffolk County , New York passed a law regulating the use of VDT's in the workplace. This law requires that employers with more than 20 terminals give 15 minute breaks every 3 hours. This law also requires that employers pay 80 percent of annual eye exams and eyeglasses. While this law allows the examination and prescription of eyewear to be performed by an optometrist , other bills of this type may not include optometry. We must work to avoid being excluded from this as we have from certain

alternative health care delivery systems.

Another service which optometry may provide for business is a routine screening program for all VDT operators in a given company. The employment of such a screening would, of course, need to be approved by the employer.

A modified clinical technique is probably the best type of screening to use. The American Optometric Association recommends the following tests when performing a MCT:[25]

1. Examination of the external eye.
2. Ophthalmoscopy.
3. Distance visual acuity.
4. Retinoscopy
5. Near visual test based on reading performance (at 35-40 centimeters and at habitual working distances).
6. Amplitude of accommodation.
7. Assessment of near heterophoria (at 35-40 centimeters and at habitual working distances).
8. Amplitude of convergence.
9. Color vision assessment.

When using the MCT to screen VDT operators it will be necessary to change the criteria for referral from the traditional AOA guidelines. The criteria for referral should be reduced in order to effectively screen all those who may experience vision problems when operating a VDT.

CONCLUSION

Optometry needs to be well informed and active in the continuing dispute concerning the visual welfare of the VDT operator and whether or not the employer has the obligation to pay for their eye care. Speaking to VDT operators may provide an avenue for practice development while also helping to inform both sides in this dispute concerning the true hazards

and misconceptions involving the use of VDT's.

Optometry can play a key role in increasing the comfort and productivity of VDT workers. We may do this by prescribing lenses , tints , providing vision therapy , or by encouraging proper ergonomic and environmental design in the workplace. As the number of VDT operators continues to increase , they will become a larger part of every optometric practice. The ability to meet the special needs of this segment of the population may well determine the degree of success of an optometric practice.

REFERENCES

1. AOA News , March 15 1988 Vol 26 , number 18 pg 6.

2. Rosenthal S. Transatlantic Views on VDU's , The Ophthalmic Optician 1981; 21:646.

3. Rey P. , Meyer J.J. Visual Impairments and Objective Correlates. Ergonomic aspects of visual display terminals. London:Taylor and Francis Ltd. , 1980.

4. Campbell F.W., Durden K. The Visual Display Terminal:A Consideration of its Physiological, Psychological and Clinical Background. Ophthal Physiolog Opt 1983 3:176.

5. National Research Council , Committee on Vision: Video Displays , Work , and Vision. Washington DC , National Academy Press ,1983; pp8-10.

6. Grundy J.W., Rosenthal S.G. VDU's On Site. The Ophthalmic Optician 1982; 22:505.

7. Sivak J.G., Woo G.C. Color of Visual Display Terminals and the Eye , Green VDT's Provide the Optimal Stimulus to Accommodation. Am J Opt Physiolog Optics 1983; 60:640-643.

8. Miller S.C., The Eye Care Book for Computer Users, Eye Care Concepts inc. , St. Louis MO. 1986; pp. 27-28.

9. Indirect Lighting For CRT Environments. Lighting Design and Application April 1982; 12:4.

10. Murray WE et al (Eds), Potential Health Hazards of Video Display Terminals, Cincinnatti , OH 1981; pg 25.

11. Margach C.B. Optometric Extension Program , Video Display Terminals 1982; Series 8:2.

12. Miller S.C., Meeting the Eyecare Needs of Video Display Terminal Operators August 1984 ; 55:614

13. IBM Corporation: Human Factors of Workstations With Display Terminals, 2nd edition. San Jose CA, 1979; pp.31-35.

14. Miller S.C., Tuning into VDT Users. Optom Management 1987; 23:27-32.

15. National Institute for Occupational Safety and Health. Potential Hazards of Video Display Terminals. Washington D.C. : U.S. Dept. of Health and Human Services , June 1981.

16. Ostberg O. Accommodation and Visual Fatigue in Display Work.University of Lulea (Sweden); 1981.

17. Miller S.C., Tuning into VDT users. Optom Management 1987; 23:27-32.

18. Pamphlet. Update on VDT's-Health and Safety Considerations. Ontario Hospital Association, November 1980.

19. Grundy J.W. , Rosenthal S.G. VDU's on Site. The Ophthalmic Optician 1982; 22:504.

20. NIOSH. Potential Health Hazards of Video Display Terminals. Dept. of Health and Human Services. Cincinnatti , Ohio: 1981

21. Durden K., Campbell F.W., The Visual Display Terminal Issue : A Consideration of its Physiological, Psychological, and Clinical Background. Ophthal Physiolog Opt 1983; 3:184.

22. Chakman J., Guest D.J., Vision and the Visual Display Unit. Aust J Optom 1983 66:134

23. Optical Radiation Corporation 1300 Optical Drive, Azusa CA 91702.

24. Miller S.C., Meeting the Eyecare Needs of Video Display Terminal Operators August 1984 ; 55:614

25. Chakman J. , Guest D.J. , Vision and the Visual Display Unit. Aust J Optom 1983; 66:135.